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TOY ROCKET MOTOR

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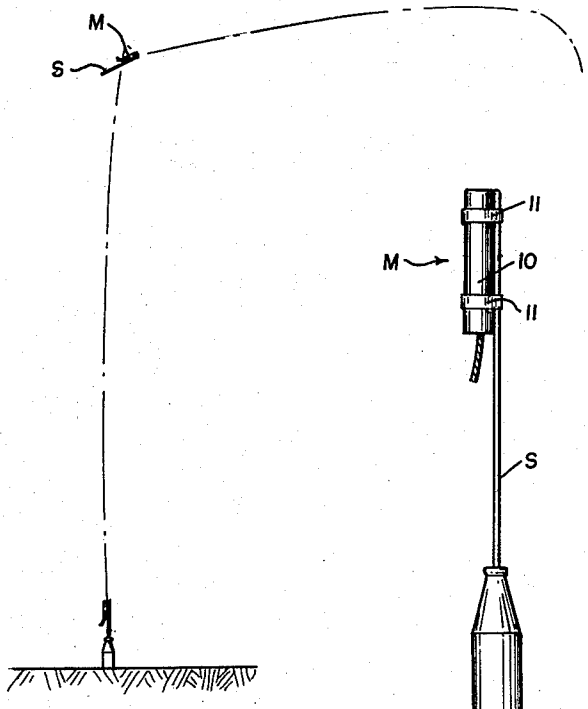


Fig. 5

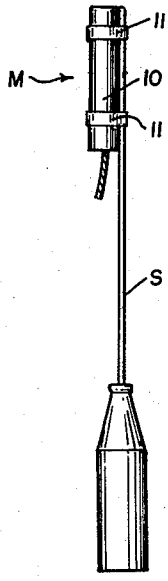


Fig. 1

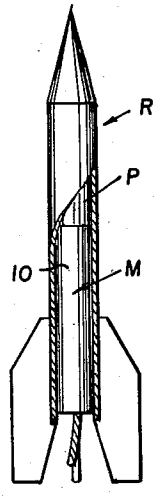


Fig. 2

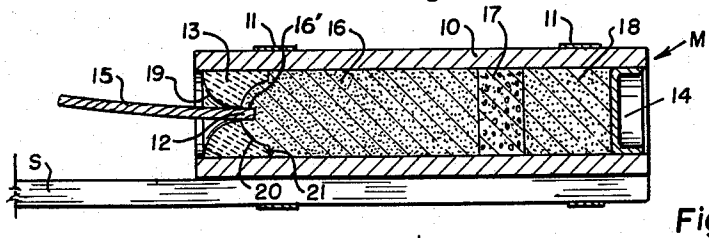


Fig. 3

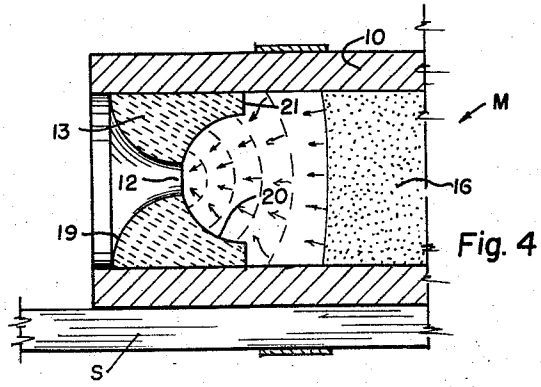


Fig. 4

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# 3,125,955
# TOY ROCKET MOTOR

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2 Claims. (Cl. 102—34.2)

This invention relates to rockets of the type which are used as models, toy parachute projectors and for fireworks display purposes, and more particularly to the propelling devices for rockets, a primary object of the invention being to provide a novel and improved propelling unit for a rocket. As such the invention will be hereinafter referred to as a rocket motor.

Another object of the invention is to provide a novel and improved rocket motor which is equally well adapted to be mounted upon a guide stick to form the rocket per se or to be placed in the motor tube of a more elaborate type of rocket shell, of the type which may include a toy parachute or explosive pyrotechnic charge.

Another object of the invention is to provide a novel and improved rocket motor having a variable or intermittent driving thrust adapted to permit directional variations of the flight path of the rocket.

Another object of the invention is to provide a novel and improved rocket which will change its direction of flight as from an ascending flight to a horizontal flight according to a predetermined arrangement.

Another object of the invention is to provide in a rocket motor, an improved form of exhaust orifice which permits efficient burning of a solidly packed propellant charge without excessive pressure peaks of the sort which are known to rupture the sidewalls of a rocket body and which permits the propellant charge to develop a substantial thrust throughout the burning period.

Yet another object of the invention is to provide a novel and improved rocket motor which is a compact, neatly-formed, low cost, efficient and versatile unit.

With the foregoing and other objects in view, all of which more fully hereinafter appear, my invention comprises certain novel and improved constructions, combinations and arrangements of parts and elements as hereinafter described, defined in the appended claims and illustrated in preferred embodiment in the accompanying drawing, in which:

FIGURE 1 illustrates the rocket motor attached to a guide stick to form a pyrotechnic device, and illustrates further, the unit mounted in a bottle, as is a common practice for mounting such toy rockets preliminary to firing them.

FIGURE 2 illustrates the rocket motor as being mounted within a rocket of more elaborate construction, with portions of the rocket being broken away to illustrate the arrangement of the motor and other constructions therewithin.

FIGURE 3 is a longitudinal sectional view of the motor and portion of a guide stick, similar to the FIG. 1 construction but on an enlarged scale.

FIGURE 4 is a fragmentary sectional detail of a portion of the showing at FIG. 3 but on a further enlarged scale and with broken lines illustrating diagrammatically, the manner of the burning of the rocket propellant at the discharge orifice.

FIGURE 5 illustrates, on a reduced scale and in a somewhat diagrammatic manner the path of a rocket using the improved motor.

The ordinary construction of the comparatively small rockets which are used as models, toy parachute projectors, fireworks displays, signals and the like is to compact a gas-forming propulsive charge of powder, into a tubular case, with propulsion being effected by high velocity discharge of gas from the rear end of the tube to reactively drive the case forming the body of the rocket in



a forwardly direction in opposition to the gas movement. Ordinarily, the gas-forming propulsion charge will be ignited at the rear end of the rocket to start with a burning action and such burning will continue until the charge is burnt out. This terminates the propulsive life of the rocket. This propulsive charge will send the rocket aloft in a substantially straight path or flat trajectory and when the burning-out action is completed the rocket will coast for awhile depending upon the speed it attains, and then fall back to the earth along a trajectory determined by the gravity force of the earth. Parachutes, pyrotechnic devices, and the like may be carried aloft by such a rocket.

Although there have been extensive developments of different forms of rockets and the propulsive charges and the timing, speed and distance a rocket will travel can be determined with considerable precision, there is still a need for further improved rocket constructions and rocket motor units which will do more than simply send a rocket aloft along a fixed trajectory. There is especially a need and demand for a rocket or rocket motor which will function to change the trajectory, for example to provide a path of movement where the rocket will ascend to a selected height and then change direction to move along a more nearly horizontal path. This not only provides for an attractive toy but also where pyrotechnic displays are being shot into the air by rockets, it is sometimes desirable to explode these displays over a body of water a substantial distance from where they are fired as from the shore.

With such in view, the present invention was conceived and developed and comprises, in essence, an improved and simplified rocket motor construction wherein the thrust of the propulsive charge will vary according to selected time intervals or intermittently as from a maximum thrust to a minimum thrust and again to a maximum thrust in such a manner that a changing trajectory can be obtained.

Also, in developing a rocket or rocket motor which would have such desirable characteristics, it was discovered that the form of the orifice through which the propulsive gases were ejected at the rear of the motor was a critical factor in obtaining efficient propulsion, and in connection therewith, an improved and modified orifice construction was developed.

Referring more particularly to the drawing, my improved rocket motor M is preferably designed as a short cylindrical unit having a rigid tubular body 10 which holds the propulsive charge. This motor M may be affixed to a guide stick S by wrapping 11 to form an individual and complete rocket as illustrated at FIG. 1. The motor M may be also carried within the body of a toy rocket R as illustrated at FIG. 2. Such a rocket body R is usually a light cylindrical shell carrying suitable guide fins, and it may be recovered and a new motor charge placed therein. It may also include a parachute P or even an explosive charge at its head above the motor M.

The body 10 is formed as a compressed laminated paper tube according to conventional practice or of any other similar light-weight rigid and strong material. The length and diameter of the tube forming the body 10 is such that a propulsive charge of powder compressed within the body will burn with maximum efficiency for a selected time period. The burning action will discharge the propulsive gas rearwardly and through an orifice 12 at the rear end of the tube. This orifice is formed by a ring 13 of refractory material. The propulsive charge is compressed within the body against this ring as hereinafter described, and the forward end thereof is closed by a cap 14. A fuse 15 is conveniently extended through the orifice 12 and into the propulsive charge a short distance to ignite the powder charge adjacent to the orifice so that the burning of the powder will commence from

the orifice and move forwardly through the tubular body. Although the unit is illustrated and hereafter described as being ignited by a fuse 15, it is to be understood this rocket motor may also be ignited by other means such as by an electrically heated wire which is extended through the orifice 12 in the same manner as the fuse.

The propulsive charge is of a conventional material such as black blasting powder which will burn at any desirable rate depending upon how the powder is compacted and blended with other material. In accordance with the teaching of the invention the propulsive charge is arranged to provide a variable thrust as an initial maximum thrust followed by a minimum thrust and returning again to a maximum thrust during the flight of the rocket and before the charge is burnt out. Basically the propulsive charge is formed in three sections. A first or primary propulsive charge 16 is made of a compressed high-power black blasting powder and is located in the rear section of the rocket body adjacent to the orifice 12. A second charge, a delay charge 17 is formed of a crude slow burning black powder or ordinary black powder having an additive such as potassium nitrate which slows the burning rate of powder. This charge adjacent to the first and within the body 10 will burn without any significant propulsive effect. A third charge at the front end of the rocket, a secondary propulsive charge 18 is again a tightly compressed high-power powder, the same as the primary charge 16. The cap 14 at the front end of the unit is more for protection against moisture and need not be of a heavy construction where the second propulsive charge is so compressed.

A rocket constructed as disclosed will travel along a changing course as illustrated at FIG. 5, upwardly and then horizontally. A pyrotechnist can provide selective amounts of the proper powder for the primary, delay and secondary charges 16, 17, and 18 once this arrangement of powder charges and the desired operation is pointed out to him. As illustrated at FIG. 5, it is desirable first to shoot the rocket upwardly along a substantially vertical path a selected distance in the air and this is accomplished by the burning of the primary propulsive charge 16. Then the rocket will coast to its apex point of flight for a period while the delay charge 17 is burning. While the rocket is coasting it will naturally tip either into the wind or out of the wind depending upon its center of gravity and the guide vane, or guide means, arrangement on the body of the rocket. For example, in the construction illustrated at FIG. 1, using a guide stick S below the base of the rocket the tipping will be into the wind. In the example illustrated at FIG. 2 the rocket body may tip into or out of the wind as desired by shifting the weight of the rocket body. This can be easily determined by simple tests.

Following the burnout of the delay charge 17, timed to permit a substantial tipping, the secondary charge 18 is ignited and this charge drives the rocket in a more nearly horizontal direction for a substantial distance. When the secondary charge 18 is burnt out the rocket will then fall to the earth.

In placing a powder charge in a rocket or a rocket motor the usual practice is to provide a longitudinal pocket within the center portion of the charge for such is necessary for efficient rocket construction. Although it would appear to be desirable to fill the space in order to compact the size of the motor or provide for a larger charge of fuel. It is commonly observed that whenever the fuel is charged as a solid mass there is a tendency for a blowing-out or rupture of the sidewalls of the rocket body adjacent to the discharge orifice if a highly efficient rocket is designed. This initial high-pressure action is caused primarily by the necessary pocket 16' formed in the end of the powder charge 16 which holds the fuse 15, for this pocket 16' will cause the powder to commence burning over a greater area and actually if too deep will explode the rocket. However, in the present design a solidly packed fuel charge is used, which burns from the rear end of the body 10 to discharge through the orifice 12 in a manner which does not create explosive pressures.



The ring 13 is formed of a refractory material with the boundaries being simply diverging from the orifice in a rounded pattern as at 19 for structural rigidity. However, the surfaces of the ring forwardly of the orifice are formed substantially spherical as at 20 with a shoulder 21 adjacent to the inner, tubular wall of the body 10. It was discovered that with such a spherical surface 20, or similar forwardly-diverging surface, no initial excess pressure occurred and that the thrust caused by the burning powder was substantially uniform through the burning period. The commonly observed burning pattern of such types of rockets, the hazardous abnormal maximum thrust at the beginning of the burning period was avoided. Evidently the burning of the powder commencing at the fuse pocket 16' will spread in a somewhat spherical manner complimentary to the form of the surface 20 as indicated in broken lines at FIG. 4. Such a burning pattern causes gas movement without creating static pressures at the wall of the body 10. On the other hand, once the burning is a substantial distance away from the orifice the direction of gas movement is more nearly axially and still toward the orifice. The uniform thrust obtained with an orifice ring 13 having a spherical inner wall 30 permits the construction of the sidewalls of the body 10 to be of minimum thickness over that ordinarily required for comparable rocket motors of this type.

I have now described my invention in considerable detail and it is obvious that others skilled in the art can design and build alternate and equivalent constructions which are within the spirit and scope of my invention; hence, I desire that my protection be limited not by the constructions illustrated and described but only by the proper scope of the appended claims.

I claim:

1. In a toy rocket, the combination of an elongated rocket body, a multiple stage unit motor charge means, and aerodynamic guide means carried by said rocket body for causing said rocket body to tip from one position to another position during a delay in propulsion thereof, said motor charge means being disposed within said rocket body and having one open end forming a discharge orifice, said motor charge means comprising ignition means at said discharge orifice, rapid burning propulsive first charge means for moving said rocket body along a first path in a first position with the longitudinal axis thereof extending in a first general direction, slow burning delay second charge means for providing a delay in propulsion of said rocket sufficient to permit said aerodynamic means to cause said rocket body to tip to a substantially different second position with the longitudinal axis thereof extending in a second general direction at least substantially transverse to said first general direction, and rapid burning propulsive third charge means for moving said rocket body along a second path in said second general direction, said first, second and third charge means being a compressed tubular cylindrical body with said first, second and third charge means in longitudinal alignment and abutting contacting successive burning transfer relation, said first charge means being disposed adjacent said discharge orifice, said first charge means forming a substantial portion of said compressed cylindrical body.

2. In a toy rocket, the combination of an elongated rocket body having forward and rear ends, a multiple stage unit motor charge means, and aerodynamic guide means carried by said rocket body for causing said rocket body to tip from one position to another position during a delay in propulsion thereof, said aerodynamic guide means comprising an elongate rod attached to the side of said body and extending beyond the rear end of said body, said motor charge means being disposed within said rocket body and having one open end forming a dis-

charge orifice facing the rear end of said body, said motor charge means comprising ignition means at said discharge orifice, rapid burning propulsive first charge means for moving said rocket body along a first path in a first position with the longitudinal axis thereof extending in a first general direction, slow burning delay second charge means for providing a delay in propulsion of said rocket sufficient to permit said aerodynamic means to cause said rocket body to tip to a substantially different second position with the longitudinal axis thereof extending in a second general direction at least substantially transverse to said first general direction, and rapid burning propulsive third charge means for moving said rocket body along a second path in said second general direction, said first, second and third charge means being a compressed tubular cylindrical body with said first, second and third charge means in longitudinal alignment and abutting contacting successive burning transfer relation, said first



charge means being disposed adjacent said discharge orifice, said first charge means forming a substantial portion of said compressed cylindrical body.

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